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FINAL EVALUATION OF THE POTENTIAL FOR WETLANDS CREATION AT PARCEL E HUNTERS POINT SHIPYARD SAN FRANCISCO, CALIFORNIA

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ACRONYMS AND ABBREVIATIONS

AWQC	Ambient Water Quality Criteria
Bay	San Francisco Bay
bgs	Below ground surface
COC	Chemical of concern
DDT	Dichlorodiphenyltrichloroethane
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
HPS	Hunters Point Shipyard
IR	Installation restoration
msl	Mean sea level
Navy	U.S. Department of the Navy
NGVD	National Geodetic Vertical Datum (1929 Mean Sea Level (msl))
PAH	Polycyclic aromatic hydrocarbons
PCB	Polychlorinated biphenyls
RWQCB	Regional Water Quality Control Board
SFRA	San Francisco Redevelopment Agency
Sugnet	Sugnet Associates
TtEMI	Tetra Tech EM Inc.
yd^3	cubic yard

1.0 INTRODUCTION AND SCOPE OF REPORT

This report presents a preliminary evaluation of the feasibility for creating wetlands at Parcel E of the Hunters Point Shipyard (HPS) (see Figure 1). This work was undertaken by the U.S. Department of the Navy (Navy) in response to a request from the San Francisco Redevelopment Agency (SFRA) to evaluate alternatives for creating wetlands at Parcel E as part of the mitigation for wetland losses associated with the San Francisco International Airport improvement project. In addition to evaluating the tidal wetland creation alternatives proposed by Sugnet Associates (Sugnet 1998), the Navy further evaluated Parcel E for more favorable wetlands locations and/or different wetland creation alternatives (for example, seasonal wetlands).

HPS, a former naval facility, is currently being converted for civilian use. Parcel E is the portion of HPS located along the shoreline adjacent to the South Basin of San Francisco Bay (Bay) (see Figure 1). Parcel E consists of about 135 acres. Parcel E has been used as a landfill; a storage area for waste, construction, and industrial materials; and for office and laboratory buildings. This parcel has been identified as the most heavily contaminated HPS parcel (Tetra Tech EM Inc. [TtEMI] 1998a). Final Remedial Investigation and Feasibility Study (FS) reports have been issued for the parcel and recommend several remedial alternatives, which include hot spot removal and a combination of multilayer and single-layer capping of affected areas (TtEMI 1998a). A base reuse plan prepared for the site (SFRA 1997) proposes dividing HPS into a variety of uses including industrial, research and development, and open space areas. Figure 2 shows designated reuse areas for HPS, as proposed in the reuse plan.

1.1 REPORT OBJECTIVES

The following are the objectives of this report:

- To evaluate the ecological benefits, environmental and physical site constraints, and associated costs for constructing and maintaining the Parcel E tidal wetland creation alternatives proposed by Sugnet.
- To develop and evaluate the ecological benefits, environmental and physical constraints, and associated costs for constructing and maintaining other wetland creation alternatives at Parcel E.

The overall goal of the report is to assess whether creating about 15 acres of wetland habitat at Parcel E is feasible, and which alternatives (if any) are worth considering for additional evaluation. The Navy

considered 15 acres a reasonable minimum area of wetlands creation at Parcel E for the feasibility evaluation purposes presented in this report. The Sugnet report (1998) indicates that an additional 4 acres could be developed at Parcel B. Section 5.3 of this report discusses the additional potential locations in Parcel E that could be used for wetland creation if required. The evaluation presented in this report is only a preliminary, "conceptual-level" design and does not develop the optimum design and location for these wetlands. In any area proposed for wetland creation, the Navy recommends that additional site characterization be performed during the design process to further identify or confirm any environmental, construction, or permitting constraints.

2.0 SUMMARY OF PARCEL E SITE CHARACTERISTICS

This section describes the site characteristics of Parcel E and discusses the areas within Parcel E that could serve as appropriate wetland locations.

Parcel E consists of about 135 acres of shoreline and lowland coastal habitat, characterized by patches of ruderal (that is, typically weedy, dominated by non-native species) vegetation, industrial areas, non-native grasses, freshwater wetlands, and saline emergent wetlands. Ruderal habitat is the largest habitat type at Parcel E, comprising over about 46 percent of the area. Remaining habitat types at Parcel E consist of a combination of freshwater wetlands, saline emergent vegetation, intertidal habitat, and landscaped areas. Existing freshwater wetlands occur as seasonally ponded areas in Installation Restoration (IR)-01/21 and cover approximately 1.6 acres. The overall ecological value of habitat at Parcel E is considered to be low except for the very limited tidal wetlands along the shoreline.

A large portion of Parcel E (about 41 percent) was formerly industrial and is covered by pavement, associated debris, and industrial buildings. Building pads and associated site utilities, mostly abandoned, are located within Parcel E.

The future use designations of Parcel E are primarily for open space along the southern shoreline, and mixed research and development and industrial use inland (see Figure 3) (SFRA 1997).

Within portions of the open space and industrial areas, are locations that have been identified in the Parcel E FS as requiring installation of a multilayer cap to isolate a variety of chemicals of concern (COC), including metals, pesticides, polycyclic aromatic hydrocarbons (PAH), polychloronated biphenyls (PCB), and dioxins/furans. Figure 3 shows the location of these areas proposed for multilayer capping as well as the location of major site utilities and building constraints.

2.1 LOCATIONS CONSIDERED FOR WETLAND CREATION

This section describes locations considered for potential wetland creation and presents the screening criteria used to select the most appropriate areas. Sugnet's proposed tidal wetland creation alternatives are located along the shorelines in Parcel E as shown on Figure 4. In addition to the Sugnet tidal wetlands, the Navy evaluated the potential for creating additional wetland alternatives at Parcel E.

2.1.1 Criteria for Selecting Appropriate Locations for Wetlands Creation

The potential for creating wetlands at Parcel E would be limited by a combination of planning (reuse designation), environmental, and physical constraints. Wetland creation alternatives for Parcel E were considered only within the identified open space areas for two reasons: (1) open space areas are adjacent to the shoreline where more natural estuarine wetland ecosystems can be created, and (2) the other areas are designated for mixed urban and industrial uses. The criteria used to select locations for tidal and seasonal wetlands differ slightly; tidal wetlands require the excavation of materials down to elevation 0.0 feet National Geodetic Vertical Datum (NGVD), while seasonal wetlands can potentially be created on top of existing surface grades. The screening criteria used to select locations for creating tidal and seasonal wetlands are presented below.

2.1.1.1 Tidal Wetland Location Screening Criteria

The following criteria were used to select locations for creating tidal wetlands at Parcel E:

1. Within locations identified by SFRA as future open space areas (SFRA 1997)
2. Outside areas designated by the HPS Parcel E FS (TtEMI 1998a) for installation of an engineered cap for protection of human health and the environment.
3. Outside areas with extensive utilities or structures requiring removal or relocation

2.1.1.2 Seasonal Wetland Location Screening Criteria

Available locations for constructing seasonal wetlands were screened using the same criteria as tidal wetlands with the exception of the second evaluation criterion (outside areas designated for environmental capping). Because seasonal wetlands do not require excavation of materials to intertidal elevations (that is, to elevation 0.0 feet NGVD), the Navy evaluated an alternative that involves creating seasonal wetlands on top of these proposed capped areas.

2.1.2 Sites Selected for Potential Wetlands Creation

Based on the screening criteria listed above, three sites were identified within Parcel E that could be used to create wetlands. The sites evaluated are within IR-01/21, IR-02 Central, and IR-02 Southeast (see Figure 5).

The following is a brief description of these three sites:

IR-01/21 – This site covers about 46 acres in the northwestern corner of Parcel E and borders state park property. The site is primarily covered with ruderal vegetation and contains a small seasonal wetland (less than 2 acres). The shoreline is covered with riprap, rubble, and woody debris. The site contains the Industrial Landfill and Triple A Sites 1 and 16. The ground surface is predominantly exposed soil with approximately 17 percent of the site covered by asphalt or concrete pavement. The site topography is flat or sloping with surface elevations ranging from approximately 10 to 20 feet NGVD.

The COCs present at this site include metals (primarily copper, lead, mercury, and zinc), PAHs, and PCBs (TtEMI 1997). Many of the affected areas of IR-01/21 are designated to be capped to protect human health and the environment. These areas were excluded from further consideration for the tidal wetland alternative.

Groundwater across this IR site contains some concentrations of metals and organic compounds that exceed Ambient Water Quality Criteria (AWQC) (U.S. Environmental Protection Agency [EPA] 1992). The groundwater levels in the A-aquifer range from 1 to 15 feet below ground surface (bgs). Shallow groundwater at this site is influenced by the tidal waters of the Bay up to about 300 feet inland from the shoreline (TtEMI 1997). In general, groundwater in the A-aquifer flows to the south and southeast towards the Bay and to the east towards Parcel D and the sanitary sewer system.

IR-02 Central – This site covers about 18 acres along the southern shoreline (TtEMI 1997). The ground surface is predominantly exposed soil with approximately 34 percent of the site covered by asphalt, buildings, or concrete pavement. The site topography is generally flat with surface elevations of less than 12 feet NGVD. The shoreline is primarily covered with riprap, steel cable, and other metal debris. IR-02 Central contains one building (Building 600) and an adjacent road and parking lot. Consequently, this site provides poor quality habitat for wildlife.

IR-02 Central consists of the central portion of the Bay Fill Area, Triple A Sites 18 and 19, a former small arms firing range, and the eastern boundary of the radium-containing device disposal dumping area. The central land area was created with artificial fill materials, including serpentine soils; excavated Bay mud, sand, and gravel; and construction and industrial debris.

COCs in IR-02 Central include numerous metals, polychlorinated dibenzo-p-dioxins, PAHs, dichlorodiphenyltrichloroethane (DDT), chlordanes, and PCBs. Groundwater across this site contains concentrations of some metal and organic compounds that exceed AWQC (EPA 1992). The groundwater levels in the A-aquifer range from approximately 4 to 11 feet bgs. Shallow groundwater at this site is influenced by tidal waters from the Bay up to about 300 feet inland from the shoreline (TtEMI 1997). In general, groundwater at IR-02 Central appears to flow towards the Bay in the southern portion of the site and towards Parcel D and the sanitary sewer system in the northern portion.

IR-02 Southeast – IR-02 Southeast covers about 10 acres along the southeastern shoreline of Parcel E. The site topography is generally flat, with surface elevations of less than 12 feet above msl. The site is predominantly exposed soil with approximately 7 percent of the site covered by asphalt or concrete pavement. Vegetation consists primarily of sparse ruderal and non-native grasses. Several large gravel piles exist throughout the site. The shoreline is sandy and has been lined with riprap, steel cable, and other metal debris.

IR-02 Southeast comprises the southeastern portion of the Bay Fill Area. The land was created with artificial fill materials, including bedrock; Bay mud, sand, and gravel; and construction debris. Fill thickness ranges from about 1 to 36 feet. Groundwater in the A-aquifer flows predominately inland during the dry season and towards the Bay during the wet season. Groundwater levels in the area within about 300 feet of the shoreline are influenced by tidal fluctuations in the Bay. COCs identified in IR-02 Southeast include numerous metals, PAHs, PCBs, and dioxin. Groundwater across this site contains concentrations of some metals and organic compounds that exceed AWQC (EPA 1992). The groundwater levels in the A-aquifer range from approximately 5 to 8 feet bgs. Shallow groundwater at this site is influenced by tidal waters from the Bay, up to approximately 300 feet inland from the shoreline. In general, groundwater at IR-02 Southeast appears to flow inland towards the sanitary sewer system during the dry season and transition period, and towards the Bay during the wet season (TtEMI 1997).

3.0 DESCRIPTION OF WETLAND ALTERNATIVES TO BE EVALUATED

This section describes the two tidal wetland alternatives previously proposed by Sugnet (1998) and the two additional seasonal wetland alternatives developed by the Navy.

3.1 DESCRIPTION OF SUGNET ASSOCIATES WETLAND CREATION ALTERNATIVES

Sugnet Associates evaluated the potential for creating tidal wetlands at two locations at Parcel E; Alternative E1—a 6 acre tidal marsh constructed along the western part of IR-01/21 (the "panhandle") and Alternative E2—a 15 acre tidal marsh constructed within the southwestern portion of Parcel E over parts of IR-02 Central, IR-02, and IR-02 Southeast (Sugnet 1998). These tidal wetlands are proposed to be constructed to a final elevation of 0 to about 9 feet NGVD, which would require excavating existing soil. Figure 4 shows the location of the two Sugnet wetland creation alternatives.

Tidal salt marsh habitat within the Bay occurs from the highest reach of the tides to the lowest places where vascular vegetation can be found. Natural tidal marches in the Bay, contain a network of tidal channels that vary in size and complexity and serve to distribute tidal waters and upland runoff through the marsh. The native salt marsh vegetation is typically divided into two zones—high salt marsh and low salt marsh. High salt marsh is typically dominated by common pickleweed (*Salicornia virginica*), a low-growing species. Pickleweed may also mix with other salt-tolerant species, such as alkali heath (*Frankenia grandifolia)*, saltgrass (*Distichlis spicata*), marsh gum plant (*Grindelia* spp.), and jaumea (*Jaumea carnosa*). California cordgrass (*Spartina foliosa*) may dominate the deeper areas of the high salt marsh along the banks of tidal channels. High salt marsh is the preferred habitat for several sensitive species, including the endangered salt marsh harvest mouse (*Reithrodontomys raviventris*), California clapper rail (*Rallus longirostris obsoletus)*, and black rail (*Laterallus jamaicensis coturniculus*). Salt marsh harvest mice require pickleweed habitats that are adjacent to uplands where they take refuge during the highest tides. Clapper rails also use the pickleweed habitat and feed along tidal channels, which they also require for breeding. Other birds that forage in tidal channels include great blue herons, American avocets, black-necked stilts, and cormorants.

The Bay's low salt marsh is typically dominated by California cordgrass. As the low marsh is drained daily by the tide, its exposed mudflats attract a variety of shorebirds that forage on mud-dwelling invertebrates. Shorebirds that forage on intertidal mudflats include western sandpipers, dunlins, marbled godwits, willets, American avocets, and a variety of gulls. However, because of the limited

and narrow area (less than 200 feet wide) of the Sugnet proposed tidal wetlands, channel development will be minimal; therefore, support for the California clapper rail is expected to be minimal.

The Sugnet tidal wetland alternative E1 is designed to be constructed to a final elevation of 0 to 8 feet NGVD in an area that contains elevated concentrations of certain COCs (see Section 2.0). Their proposed tidal wetlands are designed to create three habitat types over a distance of about 400 feet from existing mudflats to the upland edge. These habitats include (1) mud flats, (2) salt marsh vegetation, and (3) coastal scrub and transitional upland vegetation. Salt marsh vegetation is the primary habitat type proposed for construction. The Sugnet wetland design, however, does not specify which wildlife species are targeted by their design. The Sugnet tidal wetland design requires excavating up to 10 feet of material.

Sugnet tidal wetland alternative E2 is similar to alternative E1 and is proposed to be constructed to a final elevation of 0 to 10 feet NGVD. The Sugnet design addressed groundwater impacts to both tidal wetland alternatives through the installation of a slurry wall along the upstream edge of their constructed marsh. However, this slurry wall was not considered part of a remedial alternative in the Parcel E FS (TtEMI 1998a), and therefore an additional cost item was required in the Sugnet report. Sugnet estimated wetlands construction costs assuming that the wetlands were excavated in areas containing "clean material" (Sugnet 1998, p.6).

The following items were not included in the Sugnet report:

- Removal, transport, and disposal of contaminated soils to the contour lines and grades indicated in their design
- Additional overexcavation and disposal of soils (3-foot depth) and subsequent backfill of a minimum of 3 feet of clean, fine-grained material to meet wetland creation criteria (If the soil left in place does not meet noncover wetland criteria, installation of an impermeable geomembrane above the remaining soil would likely be required in addition to clean backfill.)
- Removal and disposal of offshore sediments in adjacent Parcel F that do not meet wetland creation criteria and that would have a hydraulic connection to proposed Parcel E tidal wetlands
- Final grading and revegetation costs
- Long-term monitoring and maintenance costs
- Engineering design and permitting costs
- Costs of quality control and assurance plans required for working in the U.S. Department of Defense base cleanup system

3.2 DESCRIPTION OF NAVY WETLAND ALTERNATIVES

The Navy evaluated other portions of Parcel E to determine whether other sites existed that were more suitable for creating tidal wetlands, and to determine whether a different type of wetland (for example, seasonal wetlands) would be more suitable for Parcel E (see Section 2.1).

Locations selected for evaluating wetland creation possibilities were screened using the criteria described in Section 2.1. Based on these criteria, the Navy developed one tidal and two seasonal wetland creation alternatives in the Parcel E areas shown on Figure 5. Wetland creation alternatives developed by the Navy are described below.

3.2.1 Tidal Wetland Creation Alternative

The two Sugnet tidal wetland alternatives incorporated almost all of the area within Parcel E that is potentially available for tidal wetland creation. The Navy identified an additional small area (4 acres) in IR-02 Central that was not included in the Sugnet alternative and that could be developed as tidal wetlands (see Figure 5). The small area is between IR-02 Northwest to the west and Sugnet alternative E2 to the east (see Figure 4).

Because this area alone may be too small to support a tidal wetland habitat of significant value, the Navy concluded that this area does not justify an independent evaluation of wetland creation feasibility. Additionally, the evaluation of the Sugnet tidal wetlands Alternative E2 adjacent to this area (including environmental and cost constraints) could be applied to this tidal alternative. Therefore, the Navy believes that another analysis of this tidal wetland alternative would be redundant.

3.2.2 Seasonal Wetland Creation Alternative

The Navy developed a seasonal wetland alternative that could be created on top of existing grades at Parcel E. This alternative would consist of gently undulating lands that allow for the collection of rainwater in depressions that would remain wet from fall through spring, depending on the extent of natural precipitation, with annual and perennial grasses and sedges growing on the higher elevations. This conceptual design considers constructing ponds of varying depths to provide habitat for a diversity of wildlife including amphibians, reptiles, shorebirds, and waterfowl.

In shallower seasonal ponds (less than 4 inches deep) many smaller shorebirds, such as least sandpipers, western sandpipers, dunlins, and willets would forage for aquatic invertebrates. These

avian species prefer ponds having unvegetated edges and little or no emergent vegetation. The shallow seasonal ponds are designed to remain inundated long enough during the season to discourage weedy vegetation, yet short enough to deter the growth of emergent wetland vegetation, such as cattails.

Deeper ponds (12 to 18 inches) would provide habitat for pied-billed grebes, American coots, and dabbling ducks, such as mallards, cinnamon teals, pintails, and northern shovelers. They would also provide potential habitat for frogs and the California tiger salamander (*Ambystoma californiense*), a California species of special concern. If the California tiger salamander were introduced, it would likely use the deeper ponds for breeding and the adjacent upland areas for retreat in other seasons. Ideally, these ponds would fill up every November and stay wet through April. Ducks would forage on invertebrates, plants, and seeds. Mallards and cinnamon teals would likely nest on the deepest ponds. The upland berms around the ponds with their grasses and sedges would also provide resting and feeding areas for waterfowl and shorebirds.

The conceptual design considers the presence of an upland buffer area around the perimeter of the seasonal wetlands that would typically have a low-growing cover of grasses, sedges, and shrubs. Bird species expected to use this open habitat would include killdeer, kestrels, Northern harriers, great blue herons, American coots, tricolored blackbirds, and song sparrows. Reptiles and amphibians typical to such areas include garter snakes, fence lizards, salamanders, and frogs. Upland mammals would include a suite of mostly nocturnal species, such as mice, opossums, raccoons, and skunks.

The Navy evaluated two different areas in Parcel E for the potential to construct seasonal wetlands. The first is on top of areas proposed for the environmental multilayer cap at IR-01/21 and IR -02 Northwest, and the second is on top of areas with no current proposal for capping at IR 01/21 (panhandle area) and IR-02 Southeast (see Figure 5). Figure 6 shows a typical cross section through the proposed Parcel E seasonal wetland complex and the proposed Parcel F tidal wetland complex, such as would be constructed if this Parcel E wetland alternative were incorporated with the Parcel F remedial alternative. Creating a seasonal wetland area in Parcel E would provide a higher elevation landscape element that would fit well with the Parcel F tidal wetland remedial alternative described in the Parcel F Draft FS (TtEMI 1998b). The primary difference between constructing seasonal wetlands on areas proposed for capping versus on uncapped areas, is that a cap of low-permeability material over a geomembrane would already exist in the proposed environmentally capped areas. Therefore, construction costs for creating seasonal wetlands in these areas would be reduced. However, the construction of seasonal wetlands on top of caps to isolate contamination is not a practice commonly

implemented and would likely be viewed with skepticism by the regulatory agencies, especially the Regional Water Quality Control Board (RWQCB).

4.0 CRITERIA USED TO EVALUATE THE WETLAND CREATION ALTERNATIVES

This section presents the criteria used to evaluate each of the Sugnet and Navy wetland creation alternatives.

The alternatives described in Section 3.0 were evaluated against the following general categories of criteria:

- Environmental constraints
- Physical constraints
- Habitat value
- Consistency with proposed Parcel F remedial alternatives
- Permitability and regulatory acceptance
- Monitoring and maintenance requirements
- Capital and monitoring costs

The criteria associated with these categories are described below.

4.1 ENVIRONMENTAL CONSTRAINTS

Each wetland creation alternative was evaluated in light of environmental constraints associated with COCs that exist in Parcel E soil and groundwater (TtEMI 1998a). Concentrations of COCs in Parcel F offshore sediments were also considered in this evaluation, because tidal wetlands created in Parcel E would be hydraulically connected to the offshore sediments in Parcel F (that is, there could be a flux of sediment from Parcel F into the Parcel E proposed tidal wetlands).

Concentrations of COCs in soil were compared against RWQCB screening concentrations established for certain COCs in sediments used to create wetlands (RWQCB 1992). The RWQCB established two categories of sediment that could be used in wetland environments: cover sediment suitable for use as the top surface of a marsh, and noncover sediment containing higher concentrations of COCs that must be buried by at least 3 feet of cover sediment. Because tidal wetland alternatives in Parcel E require excavating soil to intertidal elevations (up to about 10 feet below existing ground surface), the soil remaining after excavation must also be evaluated against wetland creation criteria. In addition to containing COCs below specified concentration thresholds, cover sediments and noncover sediments must also pass certain bioassay and leaching tests. These aspects of the RWQCB wetland creation

guidelines, however, were not evaluated in this report because the Navy was not previously considering this area for wetland creation possibilities and thus, these tests were not conducted on Parcel E soil. Concentrations of COCs in groundwater were compared against the lower of the fresh and marine AWQC (EPA 1992) to assess the potential for onsite groundwater to pose a risk to biological receptors in the wetlands created in Parcel E.

4.2 PHYSICAL CONSTRAINTS

Physical site constraints, such as the presence of building pads and utilities, were considered in the evaluation process.

4.3 HABITAT VALUE

The anticipated habitat and overall wildlife value of the created wetlands was evaluated to determine the relative ecological value of each alternative.

4.4 CONSISTENCY WITH PROPOSED PARCEL F REMEDIAL ALTERNATIVES

Each wetland creation alternative was evaluated for technical consistency with remedial alternatives proposed in the Draft FS for offshore sediments in Parcel F (TtEMI 1998b). In particular, environmental constraints associated with COCs in Parcel F offshore sediments were evaluated as discussed in Section 4.1.

4.5 PERMITABILITY AND REGULATORY ACCEPTANCE

Each alternative was evaluated for the anticipated degree of difficulty (or ease) in gaining regulatory acceptance from the permitting and resource agencies.

4.6 MONITORING AND MAINTENANCE REQUIREMENTS

Each alternative was evaluated with respect to the anticipated annual monitoring, maintenance, and reporting requirements typical for wetland restoration projects.

4.7 CAPITAL AND MONITORING COSTS

Cost estimates were based on the conceptual level of design and are intended to serve as a basis for comparison between alternatives. Cost estimates for excavation and disposal of materials were taken from the draft Parcel E FS report (TtEMI 1998a), the draft Parcel F FS report (TtEMI 1998b), and the Sugnet report.

5.0 EVALUATION RESULTS

This section evaluates the wetlands creation alternatives described in Section 3.0 using the criteria described in Section 4.0. Evaluation results for each of the wetlands creation alternatives is presented below.

5.1 SUGNET ASSOCIATES PARCEL E ALTERNATIVE E1

This tidal wetlands alternative involves excavating soil and sediments from the panhandle area of IR-01/21 to restore intertidal elevations. The tidal wetlands would consist of mud flats at elevation 0.0 feet NGVD, grading gradually upwards into tidal salt marsh and an upland transition zone starting at an elevation of about 5 feet NGVD to a final elevation of approximately 10 feet NGVD. This alternative involves an area of about 6 acres and would require removal and disposal of about 117,000 cubic yards (yd^3) of fill from soil depths of at least 10 feet (Sugnet 1998).

5.1.1 Environmental Constraints

COCs in soil that exceeded RWQCB wetland creation guidelines in areas proposed for this tidal wetlands alternative are shown in Table 1. Because there are a significant number of noncover criteria exceedences, exceedences of the more stringent cover criteria are irrelevant and not presented. The following COCs were found to exceed noncover criteria: copper (3.75 feet bgs); nickel (1.25 to 3.75 feet bgs); lead (1.25 to 11.25 feet bgs); selenium (3.75 feet bgs); and zinc (1.25 to 11.25 feet bgs). Therefore, the soil in this area would not be considered suitable for wetlands creation. Additionally, the samples do not adequately define the depth of soil that might require removal for wetland restoration, because only two samples were taken below the 11.25-foot interval, one at 13.25 feet bgs and one at 21.25 feet bgs. Consequently, this alternative would likely require more than 3 feet of overexcavation, placement of clean fill, and placement of a geomembrane to isolate the wetlands from underlying contaminated soil. The excavated material would likely require disposal in a Class I landfill because soil COC concentrations are high enough (more than 10 times federal and State of California leaching standards) that leaching concentrations could exceed regulatory hazardous leaching standards.

With respect to offshore sediments in Parcel F, this tidal wetlands alternative is adjacent to Parcel F sediments that contain copper, lead, mercury, zinc, PCBs, and DDT in excess of noncover criteria. The increased tidal prism created by a tidal wetland in Parcel E would likely increase sediment transport from offshore sediments into the newly created marsh, thereby increasing the potential for

biological receptors to be exposed to Parcel F COCs (many of which are currently buried beneath the surface). Consequently, these offshore sediments would also need to be excavated (dredged), dewatered, transported, and disposed of in a suitable facility. Additionally, these offshore sediments are affected by PCBs and other likely COC sources within the Yosemite Creek Watershed. The land use along most of Yosemite Creek is primarily industrial and commercial. Groundwater in this area of Parcel E exceeds AWQC for many inorganic and organic chemicals, including the following COCs: aluminum, antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, cyanide, PCBs, PAHs, and a variety of chlorinated pesticides. Therefore, the containment wall proposed as a remedial measure for Parcel E in the FS report (TtEMI 1998a) would have to be placed further into Parcel E along the entire upgradient edge of the proposed tidal wetland.

5.1.2 Physical Constraints

No buildings or utilities are located in the panhandle area of Parcel E. There is a gravel roadway that may require a flood protection levee or may have to be relocated to avoid flooding during extreme high tide events.

5.1.3 Habitat Value

The anticipated habitat and overall ecological values of the created tidal wetlands of this alternative are anticipated to be relatively low. The narrow character of the proposed tidal wetland (less than 200 feet wide) and the absence of adequate refugia (refuge habitat) or extensive tidal channels would provide very little support for the endangered salt marsh harvest mouse and California clapper rail. Additionally, this alternative would provide minimal habitat for shorebirds and waterfowl beyond that already available in the existing mudflats of South Basin.

5.1.4 Consistency with Proposed Parcel F Remedial Alternatives

This tidal alternative would not work well with the existing and proposed environmental conditions at Parcel F. Specifically, creating tidal wetlands in Parcel E would require removing offshore sediments in the South Basin area because of COCs that exceed wetland creation criteria (see Section 5.1.1). Because of sediment resuspension during dredging operations and exposure of COCs buried beneath the surface, there may also be environmental impacts from dredging this part of Parcel F. The additional excavated volume of dredged sediment from the offshore area is estimated to be about 135,000 yd^3, based on 3 feet of dredging (TtEMI 1998b). The approximate cost for the excavation and disposal of these offshore sediments has been included in Table 2.

5.1.5 Permitability and Regulatory Acceptance

This tidal alternative could be permittable by regulatory agencies because of general public and agency goals to restore tidal wetlands habitat within central San Francisco Bay. However, because of the potential for exposure of the created wetlands from other sources at HPS or for recontamination from upstream sources in Yosemite Creek, extensive permitting constraints may result from local, state, and federal regulatory agencies.

5.1.6 Monitoring and Maintenance Requirements

This alternative would have relatively high environmental monitoring requirements because of the potential exposure of wildlife to COCs. Maintenance requirements would also be relatively high, considering the location at the furthest end of the South Basin, which would tend to collect tidal debris that would periodically have to be removed. Typical monitoring requirements for tidal marshes include annual surveys of percent of vegetation cover and type, as well as periodic biological surveys to assess bird and wildlife usage of the site.

5.1.7 Capital and Monitoring Costs

The estimated costs of construction and monitoring of this alternative are included in Table 2. The cost for implementing this alternative is extremely high (more than $40 million) because of excavation and disposal costs for soils from this site and offshore dredged sediments that exceed wetland creation criteria.

5.2 SUGNET ASSOCIATES PARCEL E ALTERNATIVE E2

This 15 acre tidal wetland alternative would involve excavating soil and sediments from across Parcel E Sites IR-02 Central, IR-03, and IR-02 Southeast to restore intertidal elevations. The wetlands to be created would consist of tidal mudflats and salt marsh vegetation ranging in elevation from 0.0 to about 5 feet NGVD, where the marsh grades upwards to the existing site elevation at about 9 to 12 feet NGVD. This alternative would require about 128,000 yd^3 of soil excavation from depths of at least 10 feet (Sugnet 1998).

5.2.1 Environmental Constraints

COCs in soil that exceeded RWQCB wetland creation guidelines in areas proposed for this tidal wetlands alternative are shown in Table 1. Because there are a significant number of noncover criteria

exceedences, exceedences of the more stringent cover criteria are irrelevant and not presented. The following COCs in IR-02 Central were found to exceed noncover criteria: copper (1.1 to 6.25 feet bgs), chromium (1.12 to 36.1 feet bgs), mercury (3.75 to 6.25 feet bgs), nickel (1.25 to 36.1 feet bgs), lead (3.75 to 16.25 feet bgs), selenium (1.1 feet bgs), silver (1.0 feet bgs), zinc (1.2 to 6.25 feet bgs), and PCBs (1.12 feet bgs). COCs that exceeded hazardous concentrations were detected for mercury (6.25 feet bgs), nickel (11.1 and 26.1 feet bgs), and lead (16.25 feet bgs). The following COCs in IR-02 Southeast were found to exceed noncover criteria: cadmium (6.25 feet bgs); copper (0.75 to 16.25 feet bgs); chromium (3.75 to 11.25 feet bgs), mercury (0.75 to 16.25 feet bgs), nickel (0.75 to 11.25 feet bgs), lead (0.75 to 11.25 feet bgs), selenium (1.25 to 11.25 feet bgs), silver (0.75 to 6.45 feet bgs), zinc (0.75 to 16.25 feet bgs), PAHs (2.8 to 31.25 feet bgs), PCBs (1.25 to 8.75 feet bgs), and DDT (0.75 to 8.25 feet bgs). COCs that exceeded hazardous concentrations were detected for copper (16.25 feet bgs) and lead (0.75 feet bgs).

The soil in this area would not be considered suitable for wetland creation. Consequently, this alternative would likely require more than 3 feet of overexcavation, placement of clean fill, and placement of a geosynthetic membrane. The excavated material would likely require disposal in a Class I landfill, because soil COC concentrations are high enough (more than 10 times federal and State of California leaching standards) that leaching concentrations could exceed regulatory hazardous leaching standards.

With respect to offshore sediments in Parcel F, this tidal wetland alternative is adjacent to Parcel F sediments that contain the following COCs in excess of noncover sediment criteria: cadmium, copper, chromium, lead, mercury, silver, zinc, PCBs, and DDT. The increased tidal prism created by tidal wetlands in Parcel E would likely increase sediment transport from offshore sediments into the newly created marsh, thereby increasing the potential for biological receptors to be exposed to Parcel F COCs (many of which are currently buried beneath the surface). Consequently, these offshore sediments would also need to be excavated, dewatered, transported, and disposed of in a suitable facility.

Groundwater in this area of Parcel E exceeds AWQC for several metals and organic chemicals, including the following COCs: aluminum, antimony, arsenic, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, zinc, PCBs, PAHs, and a variety of chlorinated pesticides. Therefore, the containment wall proposed as a remedial measure for Parcel E in the FS report (TtEMI 1998a) would have to be placed further into the site along the entire upgradient edge of the proposed tidal wetland.

5.2.2 Physical Constraints

Nearby buildings and utilities located in this area would have to be removed or relocated to construct this alternative. Much of this alternative would require excavation and off-site disposal of contaminated soils from an area proposed for capping to protect human health (IR-03). The cost for this work would be very high.

5.2.3 Habitat Value

The anticipated habitat and overall ecological values of the created tidal wetlands of this alternative are anticipated to be relatively low. The narrow character of the proposed tidal wetland (less than 200 feet wide) and the absence of adequate refugia or extensive tidal channels would provide very little support for the endangered salt marsh harvest mouse and California clapper rail. Additionally, this alternative would provide minimal habitat for shorebirds and waterfowl beyond that already available in the existing mudflats of South Basin.

5.2.4 Consistency with Proposed Parcel F Remedial Alternatives

This tidal alternative would not work well with existing and proposed environmental conditions at Parcel F. Specifically, because of COCs that exceed wetland creation criteria, creating tidal wetlands in this area would require removal of offshore sediments (see Section 5.2.1). Because of sediment resuspension during dredging operations and exposure of COCs buried beneath the surface, there may be environmental impacts from dredging this part of Parcel F. The additional excavated volume of soils from these offshore areas is estimated to be about 130,000 yd^3 based on 3 feet of dredging (TtEMI 1998b). The approximate cost for the excavation and disposal of these contaminated materials is included in Table 3.

5.2.5 Permitability and Regulatory Acceptance

This tidal alternative could be permittable by the regulatory agencies because of general public and agency goals to restore tidal wetlands habitat within central San Francisco Bay. However, because of the potential for exposure of the created wetlands from other sources at HPS, extensive permitting constraints may result from local, state, and federal regulatory agencies.

5.2.6 Monitoring and Maintenance Requirements

This alternative would have moderate to high monitoring and maintenance requirements and associated costs similar to Alternative E1.

5.2.7 Capital and Monitoring Costs

The estimated costs of construction and monitoring of this alternative are included in Table 3. The cost for implementing this alternative is extremely high (about $50 million) because of the excavation and disposal costs for soils from the site and offshore dredged sediments that exceed wetland creation criteria.

5.3 NAVY SEASONAL WETLANDS ALTERNATIVES

The Navy evaluated two seasonal wetland alternatives: (1) construction on top of areas proposed in the Parcel E FS for multi-layer environmental capping (IR-01/21), and (2) construction on top of areas proposed to remain uncapped (IR-01/21 and IR-02 Southeast). These seasonal wetlands would consist of a combination of shallow, unvegetated ponds and smaller, deeper, more highly vegetated ponds. The optimum combination of pond and habitat types is not evaluated in this report; this task could be conducted during potential subsequent design phases. These seasonal wetlands would integrate well with the offshore tidal wetlands remedial option described in the Parcel F FS by creating a natural gradient of tidal and seasonal wetlands found historically throughout the Bay. Figure 6 shows a typical cross-section of a seasonal pond area. For evaluation purposes, the Navy has assumed construction of approximately 15 acres of seasonal wetlands at Parcel E. There may be additional acreage for constructing seasonal wetlands on top of areas proposed for multi-layer capping in IR-01/21. There does not appear to be any more readily available areas for constructing seasonal wetlands on top of open space areas proposed to be left uncapped.

5.3.1 Environmental Constraints

Capped Areas: This seasonal wetland alternative would integrate well with existing environmental constraints at the site, because no additional soil excavation and disposal would be required at Parcel E. Because of the creation of ponded water on top of a capped landfill, however, additional engineering and permitting measures would likely need to be implemented to ensure the integrity of the cap (see Section 5.3.7).

Uncapped Areas: Similarly, seasonal wetland creation on uncapped areas would integrate well with the existing environmental constraints at Parcel E because no additional soil excavation and disposal would be required. Many COCs in the surface and subsurface soils (0 to 3 feet bgs) in these areas, however, currently exceed noncover wetland creation criteria (see Sections 5.1.1 and 5.2.1 and Table 1). Therefore, it is likely that an engineered cap or geomembrane that goes beyond the RWQCB requirement for a 3 foot soil cap over noncover sediment would be required to ensure that COCs left below the seasonal wetland do not pose a potential impact to the wetland environment.

5.3.2 Physical Constraints

Capped and Uncapped Areas: No significant buildings or utilities exist in the areas proposed for constructing these seasonal wetlands.

5.3.3 Habitat Value

Capped and Uncapped Areas: The anticipated habitat and overall ecological value of the created seasonal wetlands is expected to be moderate. In particular, the seasonal ponds could provide significant habitat for shorebirds. However, because of the absence of significant drainage from natural upland sources, the extent of ponding would be limited to direct precipitation in the ponds or from any other on-site areas that were diverted, captured, and drained into the seasonal wetlands. The identification of any additional sources of rainwater that could be directed into the proposed seasonal ponds is beyond the scope of this report, but in principal would be feasible. As previously discussed, seasonal wetlands grading into tidal wetlands, as proposed as one remedial option in the Parcel F FS, would provide valuable habitat that has become scarce in central San Francisco Bay.

5.3.4 Consistency with Known Future Site Uses

Capped and Uncapped Areas: This area was identified from the reuse plan as an open space area (see Figure 2), therefore, the proposed wetlands creation alternative would be consistent with future SFRA reuse plans. In addition, no soil would need to be removed to accommodate this alternative.

5.3.5 Consistency with Proposed Adjacent Parcel F Remedial Actions

Capped and Uncapped Areas: This alternative would integrate very well with remedial alternatives considered in the HPS Parcel F FS. Seasonal wetlands in Parcel E combined with tidal wetlands in South Basin, considered as a remedial alternative in the Parcel F FS (TtEMI 1998c), would provide greater habitat value than the Sugnet tidal wetland alternative.

5.3.6 Permitability and Regulatory Acceptance

Capped Areas: Difficulties may occur with RWQCB permitting seasonal ponds that retain water on top of an area designated for environmental capping. The Parcel E FS (TtEMI 1998a) indicates a minimum slope of 3 percent in capped areas that would have to be revised to accommodate construction of seasonal wetland ponds.

Uncapped Areas: The alternative that involves locating seasonal wetlands on top of uncapped areas would probably be more permittable by regulatory agencies because it would not involve construction of ponded areas on top of a landfill cap.

5.3.7 Monitoring and Maintenance Requirements

Capped and Uncapped Areas: Environmental monitoring requirements for the seasonal wetlands would likely be lower than the tidal alternatives because as a result of the environmental cap, seasonal wetlands would be more isolated from potential exposure to COCs. However, maintenance requirements for seasonal wetlands may be somewhat higher than for tidal wetlands for two reasons: (1) the likely increased requirement for mosquito control in the freshwater ponds (final design of seasonally ponded areas should include easy access for mosquito control inspectors), and (2) the requirement for more active weed control to eliminate vegetation in some of the ponds.

5.3.8 Capital and Monitoring Costs

The estimated costs of construction and monitoring of this alternative are included in Table 4 (capped areas) and Table 5 (uncapped areas).

Capped Areas: This alternative would be the lowest in capital and monitoring and maintenance costs of all the alternatives (approximately $2 million).

Uncapped Areas: Capital costs would be slightly higher than creating seasonal wetlands in capped areas (approximately $3.4 million) because of costs associated with the placement of 3 feet of clean, less permeable fill over the area selected for wetlands creation.

6.0 CONCLUSION

Based on the "conceptual-level" evaluation presented in this report, seasonal wetlands would be recommended over tidal wetlands if wetlands were created at Parcel E, for the following reasons:

- Concentrations of COCs in soils in the open space, uncapped areas exceed RWQCB criteria for noncover sediment at the final marsh elevation for proposed tidal wetland alternatives, thereby requiring the excavation and disposal of large volumes of soil and sediment (approximately 280,000 to 300,000 yd^3 for each tidal alternative).
- Sediments directly offshore (in Parcel F) from the proposed tidal wetland alternatives exceed RWQCB criteria for noncover sediment, thereby requiring the dredging, dewatering, and disposing of approximately 130,000 yd^3 of offshore sediment for each tidal alternative.
- The costs for removing, transporting, disposing, and replacing Parcel E soil to create tidal wetlands are high, about $20 million. The additional costs for dredging, dewatering, transporting, and disposing of offshore sediments are also high, about $20 million. Therefore the total cost for removing and disposing of soil and sediment is about $40 million.
- Seasonal wetlands constructed in Parcel E could be integrated through a natural gradient and upland transition zone into the tidal wetlands evaluated as a remedial alternative for Parcel F. The combined tidal and seasonal wetland could recover valuable habitat historically abundant in the Bay at relatively low cost.
- The seasonal wetlands creation alternative is consistent with future SFRA reuse plans; this alternative is also substantially lower in capital and monitoring and maintenance costs than the Parcel E tidal wetland alternatives.

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San Francisco Bay

N

F

B

A

A

C

F

Yosemite Creek

South Basin

E

D

F

F

San Francisco Bay

350 0 350 700

SCALE IN FEET

Legend

PARCEL BOUNDARY

FACILITY BOUNDARY

EXTENDED IR SITE LOCATION

EXTISTING BUILDING

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DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

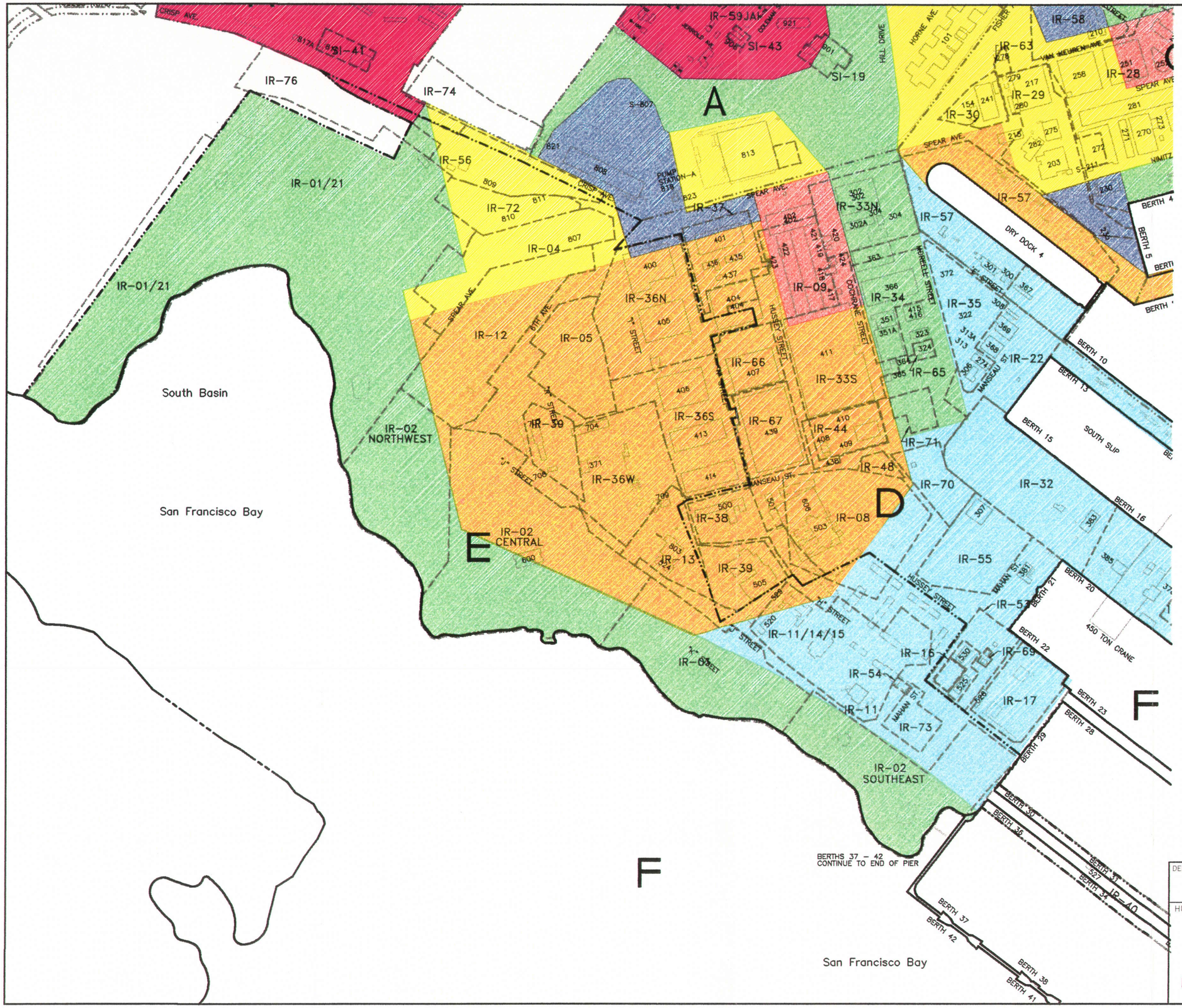
ENGINEERING FIELD ACTIVITY WEST

HUNTERS POINT SHIPYARD — SAN FRANCISCO, CALIFORNIA

FIGURE 1

FACILITY MAP

PARCEL E WETLANDS CREATION ALTERNATIVE

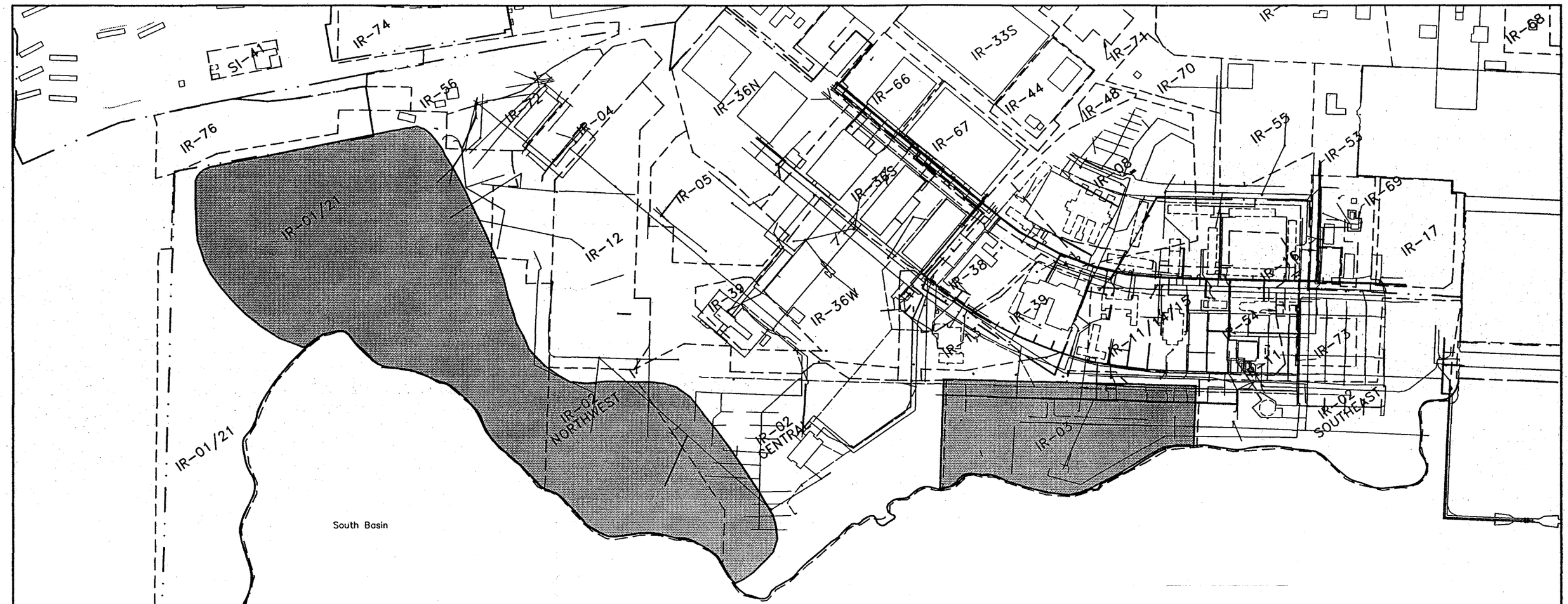


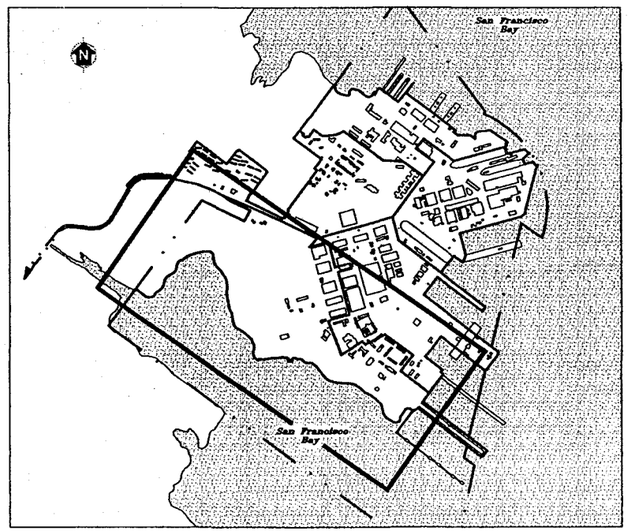
DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

ENGINEERING FIELD ACTIVITY WEST

HUNTERS POINT SHIPYARD — SAN FRANCISCO, CALIFORNIA

FIGURE 2
FUTURE DRAFT REUSE PLAN
JULY 1997
PARCEL E WETLANDS CREATION ALTERNATIVE





VIEW LOCATION

200 0 200 400
SCALE IN FEET

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

ENGINEERING FIELD ACTIVITY WEST

HUNTERS POINT SHIPYARD — SAN FRANCISCO, CALIFORNIA

FIGURE 3
SITE PLAN SHOWING AREAS TO BE CAPPED AND MAJOR UTILITIES
PARCEL E WETLANDS CREATION ALTERNATIVE

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IR-74
SI-41
IR-56
IR-76
IR-72
IR-04
IR-36N
IR-66
IR-33S
IR-74
IR-70
IR-68
IR-44
IR-48
IR-67
IR-55
IR-53
IR-08
IR-69
IR-01/21
IR-05
IR-36S
IR-12
IR-17
IR-16
IR-38
IR-39
IR-36W
IR-39
IR-11/14/15
IR-54
IR-73
IR-13
IR-11
IR-02 NORTHWEST
IR-02 CENTRAL
IR-03
IR-02 SOUTHEAST
SOUTH BASIN
IR-01/21
YOSEMITE CREEK
ALTERNATIVE E1≈6 ACRES
ALTERNATIVE E2≈15 ACRES
EXTENDED IR SITE BOUNDARY
WETLAND CREATION AREA ALTERNATIVE – SUGNET 1998
PARCEL BOUNDARY
EXISTING BUILDING
San Francisco Bay
San Francisco Bay
VIEW LOCATION
200 0 200 400
SCALE IN FEET

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ENGINEERING FIELD ACTIVITY WEST
HUNTERS POINT SHIPYARD — SAN FRANCISCO, CALIFORNIA

FIGURE 4
LOCATION OF SUGNET ASSOCIATES
PARCEL E WETLANDS CREATION ALTERNATIVES

IR-74
SI-41
IR-56
IR-76
IR-72
IR-04
IR-36N
IR-66
IR-67
IR-33S
IR-44
IR-48
IR-70
IR-55
IR-53
IR-69
IR-17
IR-16
IR-08
IR-05
IR-12
IR-36S
IR-39
IR-36W
IR-38
IR-39
IR-13
IR-11/14/15
IR-54
IR-11
IR-73
IR-01/21
IR-01/21
SOUTH BASIN
IR-02 NORTHWEST
IR-02 CENTRAL
IR-03
IR-02 SOUTHEAST
A
A'
A
A'
A
A'
PROPOSED SEASONAL WETLANDS IN UNCAPPED AREAS ≈ 4 ACRES
NAVY TIDAL WETLANDS ALTERNATIVE ≈ 4 ACRES
PROPOSED SEASONAL WETLANDS IN MULTILAYER CAPPED AREAS ≈ 15 ACRES
PROPOSED SEASONAL WETLANDS IN UNCAPPED AREAS ≈ 12 ACRES
YOSEMITE CREEK

EXTENDED IR SITE BOUNDARY

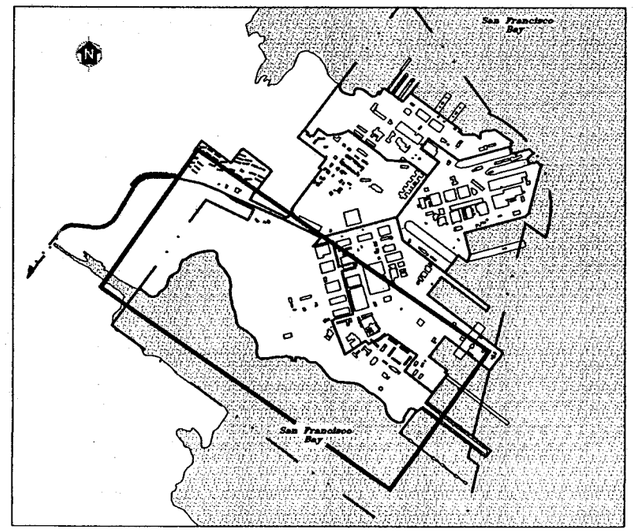
AREAS PROPOSED FOR MULTILAYER CAPPING FOR THE PARCEL E FEASIBILITY STUDY

APPROXIMATE AREA OF TIDAL WETLANDS AREA PROPOSED FOR THE PARCEL F FEASIBILITY STUDY

NAVY SEASONAL WETLANDS ALTERNATIVES

NAVY TIDAL WETLANDS ALTERNATIVES

PARCEL BOUNDARY



VIEW LOCATION

N

200 0 200 400
SCALE IN FEET

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

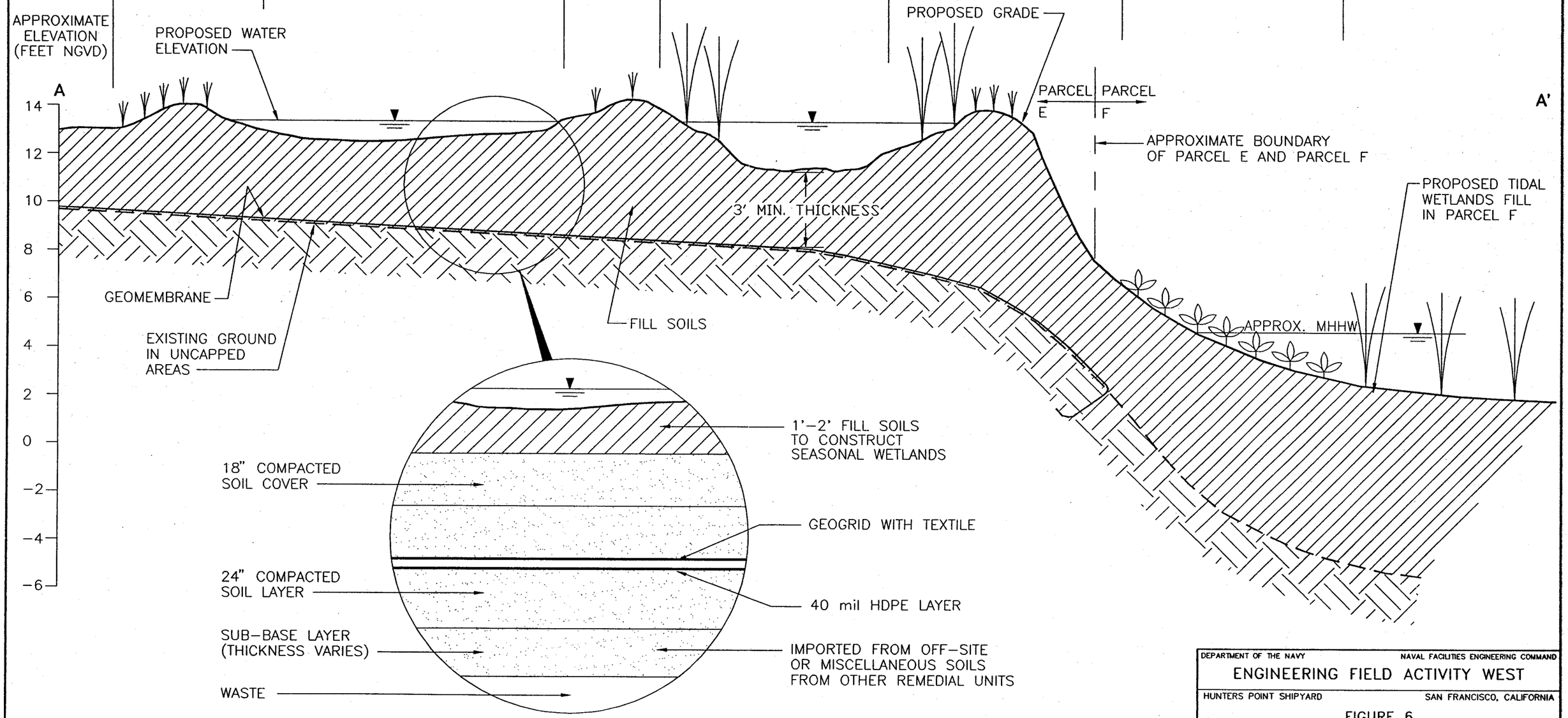
ENGINEERING FIELD ACTIVITY WEST

HUNTERS POINT SHIPYARD — SAN FRANCISCO, CALIFORNIA

FIGURE 5
PROPOSED NAVY WETLAND CREATION ALTERNATIVE
PARCEL E WETLANDS CREATION ALTERNATIVE

DCB 9/9/1998 2:03 P.M. LTScale: 0.50 Drawing File(.DWG): J:\ENGCAD\NAVY\5113\WETLANDRESTORATION.DWG

HABITAT TYPE:	UPLAND BUFFER	SHALLOWER SEASONAL WETLANDS	UPLAND BERMS	DEEPER SEASONAL WETLANDS	UPLAND BERMS	HIGH SALT MARSH	LOW SALT MARSH
WILDLIFE VALUE:	FROGS, SALAMANDERS, SMALL MAMMALS, LAND BIRDS, SNAKES	SHOREBIRDS	FROGS, SALAMANDERS, SMALL MAMMALS	WATERFOWL	FROGS, SALAMANDERS, SMALL MAMMALS	SALT MARSH HARVEST MOUSE CLAPPER RAIL	SHOREBIRDS
VEGETATION:	GRASSES, AND SEDGES	MOSTLY BARE OF VEGETATION	LOW DENSITY NATIVE PLANTS	SOME EMERGENT VEGETATION	LOW DENSITY NATIVE PLANTS	PICKLEWEED, SALTGRASS, ALKALI HEATH	CALIFORNIA CORDGRASS



MHHW – MEAN HIGHER HIGH WATER
NGVD – SITE DATUM 1929 MSL
HDPE – HIGH DENSITY POLYETHYLENE

TYPICAL CROSS SECTION IN AREAS PROPOSED FOR MULTILAYER CAPPING

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND
ENGINEERING FIELD ACTIVITY WEST
HUNTERS POINT SHIPYARD — SAN FRANCISCO, CALIFORNIA

FIGURE 6
TYPICAL CROSS−SECTION
OF PROPOSED NAVY SEASONAL WETLANDS
PARCEL E WETLANDS CREATION ALTERNATIVE

TABLE 1

SOIL COC EXCEEDENCES OF RWQCB NONCOVER WETLAND CREATION CRITERIA (IN UNCAPPED, OPEN SPACE AREAS CONSIDERED FOR TIDAL WETLANDS CREATION) PARCEL E WETLANDS CREATION EVALUATION HUNTERS POINT SHIPYARD, SAN FRANCISCO, CALIFORNIA

		IR 01/21		IR 02 Central		IR O2 Southeast	
COC	RWQCB Noncover (mg/kg)	Depths (feet bgs)	Maximum (mg/kg)	Depths (feet bgs)	Maximum (mg/kg)	Depths (feet bgs)	Maximum (mg/kg)
Arsenic	85	NE	---	NE	---	NE	---
Cadmium	9.0	NE	---	NE	---	6.25	13
Chromium	300	NE	---	1.12 to 36.1	876	3.75 to 11.25	579
Copper	390	3.75	441	1.1 to 6.25	1590	0.75 to 16.25	3,370*
Lead	110	1.25 to 11.25	1154	3.75 to 16.25	1590*	0.75 to 11.25	6,130*
Mercury	1.3		---	3.75 to 6.25	21*	0.75 to 16.25	11.8
Nickel	200	1.25 to 3.75	365	1.25 to 36.1	2090*	0.75 to 11.25	1,650.0
Silver	2.2		---	NE	---	0.75 to 6.45	2.6
Selenium	1.4	3.75	4	1.1	1.8	1.25 to 11.25	2.1
Zinc	270	1.25 to 11.25	1060	1.2 to 6.25	1304	0.75 to 16.25	2,270
PAHs	35	NE	---	3.75 to 6.25	52	2.8 to 31.25	76
PCBs	0.4	NE	---	1.12	32	1.25 to 8.75	1.6
DDT	0.1	NE	---	NE	---	0.75 to 8.25	0.37

Notes:

bgs	Below ground surface
DDT	Dichlorodiphenyltrichloroethane
IR	Installation restoration
mg/kg	Milligrams per kilogram
NE	No exceedences of noncover criteria
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
RWQCB	Regional Water Quality Control Board
*	Exceeds hazardous concentration

TABLE 2

PRELIMINARY COST TABLE
PARCEL E WETLANDS CREATION EVALUATION
SUGNET ALTERNATIVE E-1 (6 acres)
HUNTERS POINT SHIPYARD, SAN FRANCISCO, CALIFORNIA

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS
Capital Costs					
excavation of onsite soils to Sugnet grades	117000	yd^3	$20	$2,340,000	from Sugnet report
additional excavation for clean backfill	29340	yd^3	$20	$586,800	3 foot overexcavation
excavation of offshore sediments	135843	yd^3	$10	$1,358,430	from Parcel F FS
class I disposal of soil and sediment	282183	yd^3	$118	$33,297,594	from Parcel E FS
backfill with clean material (3 feet)	28340	yd^3	$18	$505,302	3 foot clean soils
installation of geomembrane	261360	ft^2	$0.8	$209,088	
installation of upgradient slurry wall	1947	lf	$150	$292,050	from Sugnet report
other (dewatering, bracing, shoring, lab)	1	ls	$2,000,000	$2,000,000	
final grading and revegetation	6	acre	$3,000	$18,000	
Capital costs: Subtotal				**$40,607,264**	
Engineering Design Costs					
engineering design	1	ls	$110,000	$110,000	
preparation of plans and specs	1	ls	$80,000	$80,000	
permitting	1	ls	$25,000	$25,000	
preparation of QA/QC plans	1	ls	$25,000	$25,000	
prep of monitoring plan	1	ls	$15,000	$15,000	
Engineering costs: Subtotal				**$255,000**	
Monitoring and Maintenance Costs					
annual habitat and wildlife surveys	1	ls	$40,000	$40,000	
debris removal and disposal	1	ls	$25,000	$25,000	
environmental monitoring	1	ls	$25,000	$25,000	
preparation of annual reports	1	ls	$25,000	$25,000	
Annual M&M costs: Subtotal				**$115,000**	
5-year M&M costs:				**$575,000**	
TOTAL: 5-year estimated				**$41,437,264**	
Estimated per acre cost:				**$2,762,484**	

Notes:

Contingency on costs not included in total

FS Feasibility Study

lf linear feet

ls lump sum

M&M monitoring and maintenance

QA/QC quality assurance/quality control

yd^3 cubic yards

TABLE 3

PRELIMINARY COST TABLE
PARCEL E WETLANDS CREATION EVALUATION
SUGNET ALTERNATIVE E-2 (15 acres)
HUNTERS POINT SHIPYARD, SAN FRANCISCO, CALIFORNIA

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST	COMMENTS
Capital Costs					
excavation of onsite soils to Sugnet grades	128000	yd^3	$20	$2,560,000	quantity from Sugnet report
additional excavation for clean backfill	73350	yd^3	$20	$1,467,000	3 foot overexcavation
excavation of offshore sediments	130283	yd^3	$10	$1,302,830	from Parcel F FS
class I disposal of soil and sediment	331633	yd^3	$118	$38,966,878	from Parcel E FS
backfill with clean material (3 feet)	73350	yd^3	$18	$1,307,831	3 foot clean soils
installation of geomembrane	653400	ft^2	$0.8	$522,720	
installation of upgradient slurry wall	3000	lf	$150	$450,000	from Sugnet report
other (dewatering, bracing, shoring, lab)	1	ls	$3,000,000	$3,000,000	from Parcel E FS
revegetation	15	acre	$3,000	$45,000	
Capital costs: Subtotal				**$49,622,258**	
Engineering Design Costs					
engineering design	1	ls	$110,000	$110,000	
preparation of plans and specs	1	ls	$80,000	$80,000	
permitting	1	ls	$25,000	$25,000	
preparation of QA/QC plans	1	ls	$25,000	$25,000	
prep of monitoring plan	1	ls	$15,000	$15,000	
Engineering costs: Subtotal				**$255,000**	
Monitoring and Maintenance Costs					
annual habitat and wildlife surveys	1	ls	$40,000	$40,000	
debris removal and disposal	1	ls	$25,000	$25,000	
environmental monitoring	1	ls	$25,000	$25,000	
preparation of annual reports	1	ls	$25,000	$25,000	
Annual M&M costs: Subtotal				**$115,000**	
5-year M&M costs:				**$575,000**	
Total 5-year estimated cost:				**$50,452,258**	
Estimated per acre cost:				**$3,363,484**	

Notes:

Contingency on costs not included in total

FS Feasibility Study

lf linear feet

ls lump sum

M&M monitoring and maintenance

QA/QC quality assurance/quality control

yd^3 cubic yards

TABLE 4

PRELIMINARY COSTS FOR CAPPED AREAS
PARCEL E WETLANDS CREATION EVALUATION
NAVY SEASONAL WETLANDS CREATION ALTERNATIVE (15 acres)
HUNTERS POINT SHIPYARD, SAN FRANCISCO, CALIFORNIA

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
Capital Costs - Capped Areas (1)				
final grading to create seasonal ponds	15	acres	$5,000	$75,000
import and placement of low permeability material	36675	yd^3	$18	$653,915
installation of geomembrane	653400	ft^2	$0.8	$522,720
revegetation	15	acre	$8,000	$120,000
Capital costs capped areas: Subtotal				**$1,371,635**
Engineering Design Costs				
engineering design	1	ls	$110,000	$110,000
preparation of plans and specs	1	ls	$60,000	$60,000
permitting	1	ls	$25,000	$25,000
preparation of QA/QC plans	1	ls	$25,000	$25,000
prep of monitoring plan	1	ls	$15,000	$15,000
Engineering costs: Subtotal				**$235,000**
Annual Monitoring and Maintenance Costs				
annual habitat surveys	1	ls	$20,000	$20,000
debris removal and disposal	1	ls	$15,000	$15,000
mosquito monitoring and control	1	ls	$20,000	$20,000
exotic weed control	1	ls	$20,000	$20,000
preparation of annual reports	1	ls	$20,000	$20,000
Annual M&M costs: Subtotal				**$95,000**
5-year M&M costs:				**$475,000**
total 5-year estimated cost for capped areas:				**$2,081,635**
estimated per acre cost for capped areas:				**$138,776**

Notes:

Contingency on costs not included in total

FS Feasibility Study

ft^2 square feet

ls lump sum

M&M monitoring and maintenance

QA/QC quality assurance/quality control

yd^3 cubic yards

(1) Assumes costs for multilayer cap contained in Parcel E FS work

TABLE 5

PRELIMINARY COSTS FOR UNCAPPED AREAS
PARCEL E WETLANDS CREATION EVALUATION
NAVY SEASONAL WETLANDS CREATION ALTERNATIVE (15 acres)
HUNTERS POINT SHIPYARD, SAN FRANCISCO, CALIFORNIA

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
Capital Costs - Uncapped Areas				
final grading to create seasonal ponds	15	acres	$5,000	$75,000
import and placement of low permeability material	36675	yd^3	$18	$653,915
installation of geomembrane	653400	ft^2	$0.8	$522,720
revegetation	15	acre	$8,000	$120,000
import of clay soils (3 feet)	72600	yd^3	$18	$1,294,458
rough grading of pond area	15	acres	$3,000	$45,000
Capital costs uncapped areas: Subtotal				**$2,711,093**
Engineering Design Costs				
engineering design	1	ls	$110,000	$110,000
preparation of plans and specs	1	ls	$60,000	$60,000
permitting	1	ls	$25,000	$25,000
preparation of QA/QC plans	1	ls	$25,000	$25,000
prep of monitoring plan	1	ls	$15,000	$15,000
Engineering costs: Subtotal				**$235,000**
Annual Monitoring and Maintenance Costs				
annual habitat surveys	1	ls	$20,000	$20,000
debris removal and disposal	1	ls	$15,000	$15,000
mosquito monitoring and control	1	ls	$20,000	$20,000
exotic weed control	1	ls	$20,000	$20,000
preparation of annual reports	1	ls	$20,000	$20,000
Annual M&M costs: Subtotal				**$95,000**
5-year M&M costs:				**$475,000**
total 5-year estimated cost for uncapped areas:				**$3,421,093**
estimated per acre cost for uncapped areas:				**$228,073**

Notes:

Contingency on costs not included in total

FS Feasibility Study
ft^2 square feet
ls lump sum
M&M monitoring and maintenance
QA/QC quality assurance/quality control
yd^3 cubic yards